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March 26, 2018

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: Viasat, Inc., *Ex Parte* Submission, IB Docket No. 17-95

Dear Ms. Dortch:

Viasat, Inc. ("Viasat") responds to a recent series of *ex parte* communications by Iridium in which Iridium asks the Commission to preclude access to the 29.25-29.3 GHz band segment by earth stations in motion ("ESIMs").[1]

There is no policy basis for Iridium's proposal to create a 50 megahertz "donut hole" in the Ka-band spectrum range that is otherwise available for satellite-delivered broadband services. Implementing this proposal would harm the public interest by limiting the availability of Wi-Fi service on airplanes, creating significant inefficiencies in spectrum use, and undermining established Commission policies.

Among other things, blocking access to the 29.25-29.3 GHz band segment would effectively mean that spectrum in that band segment could not be used to form larger ESIMs communications channels with adjacent Ka-band spectrum. Consequently, the 29.25-29.3 GHz spectrum could not be used for the types of 80, 160, and 320 megahertz channels that are needed to provide Wi-Fi service on major airlines such as American and JetBlue, which, as the Commission is well aware, have supported efforts to ensure continued access to suitable spectrum for satellite-based Wi-Fi service.[2] Furthermore, due to the high reuse factor on Viasat's high-throughput satellites, the impact of blocking access to this 50 megahertz segment would be multiplied hundreds of times over the coverage area. In short, Iridium is simply

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[1] *See, e.g.,* Iridium Communications, Inc., Notice of *Ex Parte* Communication, IB Docket No. 17-95 (filed Mar. 22, 2018) ("Iridium *Ex Parte* Letter").

[2] *See* American Airlines, *Ex Parte* Presentation, GN Docket No. 14-177, *et al*. (filed Nov. 9, 2017); JetBlue Airways, *Ex Parte* Presentation, GN Docket No. 14-177, *et al*. (filed Nov. 9, 2017).

incorrect that its unsubstantiated proposal "would have no practical impact on ESIM deployment."[3] To the contrary, enacting Iridium's proposal would directly harm the public by significantly, and unnecessarily, limiting access to critical inflight broadband capabilities that are increasingly demanded by consumers.

Nor is there any technical basis for Iridium's claims that: (i) allowing ESIMs to access the 29.25-29.3 GHz band segment would risk creating harmful interference to Iridium's non-geostationary satellite orbit (NGSO) network; (ii) there is no viable method for coordinating NGSO feeder-links and ESIMs; or (iii) "even under the best circumstances, the band would not be available for ESIMs in a substantial part of the country."[4]

As Viasat's prior analysis in this proceeding demonstrates, sharing between ESIMs and Iridium's NGSO feeder link operations is readily achievable *in all of the Ka-band spectrum assigned to Iridium across virtually all, if not all, of the United States*.[5] Indeed, this prior analysis demonstrates that ESIMs on six aircraft operating over a single geostationary orbit (GSO) satellite network would not cause any harm to Iridium.

Viasat developed a further analysis in connection with the WRC-19 agenda item on ESIMs (Agenda Item 1.5). That analysis appears as Annex 1 of Document 4A/620-E, a U.S. contribution to the most recent ITU Working Party 4A meeting. Notably, that analysis received considerable scrutiny as part of the U.S. WRC-19 preparatory process with many interested parties, including Iridium, having a chance to review and comment on it prior to the document being approved as a U.S. contribution to the WP 4A meeting. Viasat is attaching that analysis to this letter for inclusion in the record of this proceeding.

The ITU WP 4A analysis examines the sharing environment of four GSO satellite networks operating in view of the Iridium gateway facility in Tempe, AZ. It also examines ESIMs on six aircraft operating on flight paths that take them in close proximity to the Iridium feeder link station, and in some cases directly over the feeder link station. In the underlying simulation, the ESIMs are operated 24 hours per day, for 30 days, with the simulation updating every second to reevaluate the position of the ESIMs and of the Iridium satellite constellation.

Notably, that analysis demonstrates that, even assuming four different GSO networks are operating ESIMs in the vicinity of an Iridium feeder link station (without any geographic isolation), Iridium is protected to a level of -6 dB I/N more than 99.99 percent of the time. The short-term exceedances above this level are one second or less in duration, very infrequent, and unlikely to cause any impact to the Iridium system. The analysis also shows that other I/N values could be satisfied by choosing an appropriate isolation zone around the feeder link station.

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3 Iridium *Ex Parte* Letter at 1.

4 *Id.*

5 Notice of *Ex Parte* Presentation of Viasat, Inc. and Inmarsat, Inc., IB Docket No. 17-95 (filed Nov. 6, 2017).

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And the methodology used in the analysis is readily extendable to geostationary satellite systems other than Viasat's particular architecture. In other words, the analysis should disabuse *any* notion that the operation of ESIMs can be expected to cause Iridium's NGSO system "link unavailability for too high a percentage of time." In turn, this analysis should provide the Commission with comfort that granting other GSO network operators access to the 29.25-29.3 GHz band segment would not in any way limit Iridium's spectrum access, especially in locations where Iridium is not using that spectrum.

The reasons there is no realistic possibility of interference are straightforward: (i) the number of in-line events where there is a chance of an interference issue is infinitesimally low (*i.e.,* Iridium satellites will rarely "see" the ESIM transmissions); (ii) modern high-throughput broadband satellites (HTS) use lower EIRP densities (*i.e.,* they don't use a lot of power when they transmit); (iii) MF-TDMA networks use low duty cycles (*i.e.,* they are not always transmitting—typically no more than one percent of the time[6]); (iv) the Iridium satellite feeder link receive beam is relatively "deaf" compared to modern satellite receivers and with respect to unwanted energy from other sources (it is inherently capable of spectrum sharing); and (v) Iridium operates a very limited number of feeder link stations in the United States.

Finally, Viasat notes that the only reason for the lack of a practical solution to this spectrum sharing matter is Iridium's intransigence. Contrary to Iridium's hyperbolic statements, developing and implementing a sharing solution is readily achievable as an engineering matter once the appropriate level of protection is established. Viasat's long history of successfully operating Ku-band aeronautical ESIMs, while also protecting sensitive government facilities and radio astronomy, illustrates its ability to effectively share spectrum with sensitive systems. The same type of software solutions used successfully in those cases for almost 20 years can be readily adapted, as necessary, to enable sharing with Iridium.

In short, the enclosed analysis (coupled with Viasat's prior submissions in this proceeding) clearly demonstrates that there are reasonable mechanisms for ensuring compatibility between ESIMs and Iridium's feeder link operations, and that Iridium is capable of sharing its spectrum with other satellite networks on reasonable terms. The Commission should reject Iridium's long-tired refrain that it is incapable of sharing spectrum—sharing that the Commission always intended Iridium to effect, and that existing rules already require.[7]

Respectfully submitted,

/s/ John P. Janka
John P. Janka
Elizabeth R. Park

Counsel to Viasat, Inc.

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6 Long term average value.

7 *See* 47 C.F.R. § 25.258.

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ANNEX 1

Study for analyzing compatibility between airborne ESIM and non-GSO MSS feeder links in the 29.1-29.5 GHz band

To simulate the effects of a number of aeronautical ESIMs operating within multiple GSO networks, the Iridium MSS feeder link was modeled in Visualyse Pro software using the notified characteristics of the HIBLEO-2FL system.[8] The simulation also included a number of ESIMs using characteristics representative of those stations that will operate with the ViaSat-2 satellite. The characteristics used in the simulation for the HIBLEO-2FL and for the ESIMs are given in Tables 1 and 2 below.

TABLE 1

HIBLEO-2FL Characteristics

Parameter / Description	Value
Satellites	66 with orbital characteristic per HIBLEO-2FL filing
Orbital planes / satellites per plane	6 planes / 11 satellites per plane
Orbital height	780 km
Orbital inclination	86.4°
Orbital period	100 min
Feeder link frequency (uplink)	29.1-29.3 GHz
Feeder link polarization (uplink)	RHCP
Satellite FL beam receive antenna gain	30.1 dBi
Satellite FL beam antenna pattern	S.465
Satellite FL beam receive system noise	1295 K
Satellite FL beam G/T (calculated)	-1.02 dB/K
Feeder link emission designator	4M38Q7W
Earth station tracking scheme	Tracking based on longest hold time with 5° minimum elevation at earth station
Tracked earth station	Tempe, AZ

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8 The US has filed additional coordination requests for the HIBLEO-2FL System. These are HIBLEO-2FL2 and HIBLEO-2FL2 Mod-1. This analysis only considers filings that are currently brought into use and additional studies may be required to address the new HIBLEO-2FL2 filings once Notified.

HIBLEO-2FL Assumptions

The HIBLEO-2FL system is assumed to be operating using the Tempe, AZ gateway earth station, and per advice from the operator, that the earth station is tracking the desired satellites using a longest hold time strategy with a minimum elevation at the earth station of 5° above the local horizon. The output power of the gateway earth station was not considered as this analysis only examines received I/N at the spacecraft and does not consider C/I, C/N, or C/(N+I).

TABLE 2

ESIM Characteristics

Antenna diameter (major axis)	78 cm
Antenna gain	40.5 dBi
Antenna input power	14 dBW
e.i.r.p density per carrier (single per ES)	35.5 dBW/MHz
Carrier emission designator	80M0G7D
Carrier frequency	29.2 GHz
Carrier polarization	RHCP
Carrier burst duty cycle	6%
ESIMs in simulation	24
ESIMs per GSO satellite	6
Target GSO satellite locations	-107, -89, -79, -55

Aeronautical ESIM assumptions

- The ESIMs are representative of those of one satellite network operator and may not be representative of ESIMs used with other satellite networks.
- The ESIMs are assumed to each operate on the same frequency (29.2 GHz) and that this is both co-frequency and co-polar to the HIBLEO-2FL feeder link channel being evaluated.
- ESIMs are operating at 10.7 km and flying at normal cruise speeds.
- Each ESIM is traveling between a city pair for which the flight path will cross over or near the Tempe, AZ gateway facility.
- At the conclusion of each flight within the simulation, the flight restarts and repeats the previous flight path. This continues for the duration of the simulation.
- The simulated ESIM antenna patterns take into account variations due to skew angle.

Analysis

The analysis runs over a 30-day simulation period in a step size of one second. In each step, the positions of the Iridium satellites in the constellation are updated and the pointing angle between the Iridium gateway and the tracked satellite are updated, as is the pointing of the satellite's receiving beam toward the gateway. The locations of the ESIMs are updated by using the define variable feature in Visualyse to update the latitude and longitude of the stations according to a table of waypoints for each station.

As the ESIMs move through the simulation, they burst according to the settings for each in the traffic module of Visualyse. In this simulation the ESIMs are all configured with a burst duty cycle of 6%. The 6% duty cycle is calculated asynchronously for each earth station. Accordingly, in the simulation, there is a small possibility that multiple earth stations may burst at the same time. In a real MF-TDMA network, multiple co-frequency co-time bursts will not occur in a given satellite beam.

Figure 1 shows a snapshot of the ESIM locations at one point in time of the simulation. The figure also shows a snapshot of the -3 dB receiving beam contour on the earth at a given point in time,. In this snapshot approximately six ESIMs are within the receiving beam.

FIGURE 1

Simulation Map View

In the simulation, each ESIM will transmit to one of four GSO satellites defined in the simulation. The orbital locations used were 107 W.L., 89 W.L., 79 W.L, and 55 W.L. The target GSO satellite for each ESIM is fixed for the duration of the simulation.

Given the city pair sets chosen for each ESIM, the length of time required for the flights to complete vary, leading to variable times of the day over which the flights cross over or near the Tempe, AZ gateway. Also, because of the variable flight lengths, the density of aircraft over or near the gateway vary during the simulation.

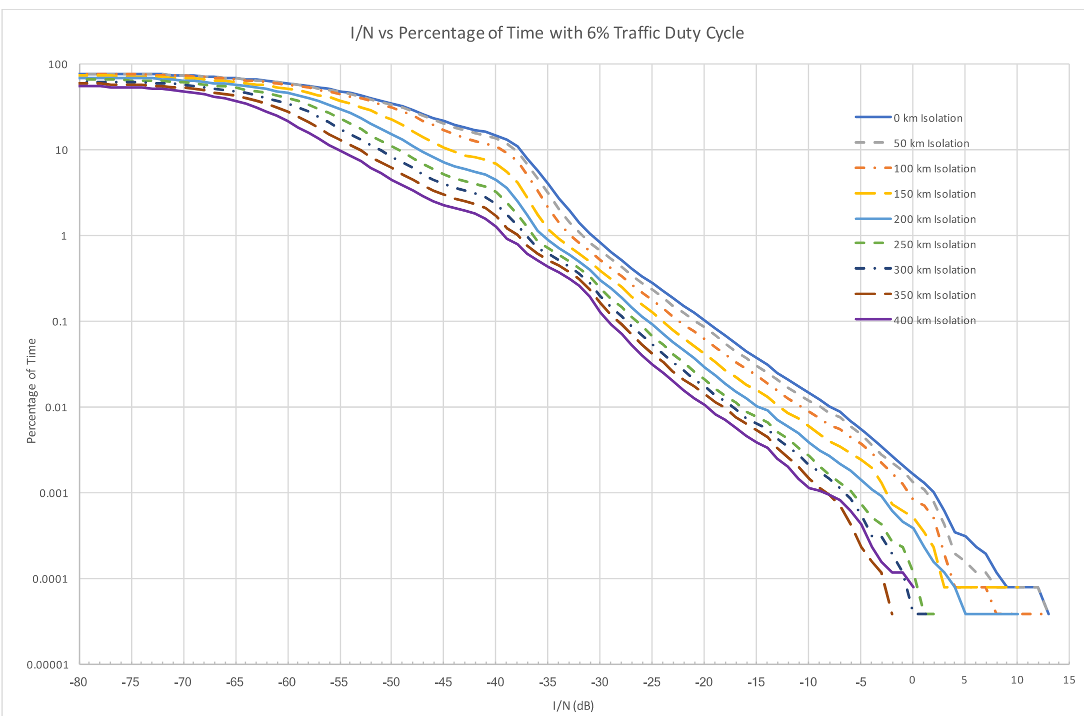
It is worth noting that, in the simulation, the ESIM flights continue unabated 24 hours per day over the length of the 30-day simulation, unlike actual commercial air flight operations, which have a cycle over a given day with some flights starting in the morning and building during the day, then dropping off overnight. This is in contrast to land or maritime ESIMs which may be in the vicinity of the gateway over long periods depending on their operational characteristics.

The same Visualyse traffic module used to control the burst duty cycle also allows for use of an isolation zone around a station where transmissions from that particular bursting station are not allowed. Multiple simulations were run using various circular isolation zones from 0 km to 400 km in 50 km steps.

Figure 2 shows the results of these simulations and depicts the CDF of the I/N as a percentage of time.

FIGURE 2

CDF of I/N vs Percentage of Time



Summary of Study

The long term aggregate I/N of -12.2 dB for 10% of the time is never exceeded. The long term single entry I/N of -18.2 dB for four GSO systems is also never exceeded, even with no isolation zone over the gateway.

Given that the simulation reports an I/N of approximately -37.5 dB 10% of the time even with no isolation zone with the aggregate transmissions of four GSO ESIM networks, which is 25.3 dB less than the target goal, it is obvious that no isolation is needed to meet the long-term criteria for the four GSO networks used in this example simulation.

For short term I/N and % time criteria, Figure 2 shows a sensitivity analysis of impact of size of circular isolation zones on received interference.

It should also be noted that the curves in Figure 2 represent results based on the characteristics of one GSO operator, and that entirely different sets of curves could be obtained by changing ESIM terminal transmission characteristics, the number of ESIMs, as well as the operational flight patterns, altitudes and frequency of flights for these ESIMs.

The range, variation and limits of these parameters are areas for potential additional studies to help provide a basis for determining an accurate zone where operational controls may be required.

Similar, future studies involving land and marine ESIMs are needed to determine compatibility with non-GSO MSS feeder links.